REMARKS/ARGUMENTS

Claims 1-48 remain in the application. No claims are amended. Claims 37-48 are newly cancelled. Claims 49-53 are newly presented.

Information Disclosure Statement

The Examiner is thanked for acknowledging and reviewing the Information Disclosure Statement previously filed.

Election/Restriction

Claims 1-48 were subject to a restriction requirement. The Applicant elects claims 1-36 for prosecution in the present application. Claims 37-48 are withdrawn from consideration and cancelled. However, the Applicant reserves the right to pursue cancelled claims 37-48 in one or more Divisional applications to be filed during the pendency of the instant application.

Claim Rejections Under 35 USC § 102

Claims 1-3, 6, 10-25, 28 and 34-36 were rejected under 35 USC § 102(b) as being anticipated by US Patent 5,968,111 to Bae, et al.

The present invention recited in claim 1 is a method for filtering data, wherein a plurality of data samples is received; a locus of the samples is computed; a value of an input sample is normalized to a range centered on the locus; and only then are the data passed through a distance-based filter. Thus, according to the present invention, the input data are normalized **prior** to filtering.

In contrast, Bae et al. teaches an eight-degree circular median filter having a data sorter 20 that sorts newly input data in a magnitude sequence. The sorted data stored are in median cells 21-29 before being supplied to a median determiner 30. The median cells 21-29 supply the sorted data to a distance calculator 31 and a multiplexer 33 in the median determiner 30. Column 2, lines 40-59, which reads as follows:

> FIG. 3 shows a circular median filter according to a preferred embodiment of the present invention, and shows an example of eight-degree circular median filter. In FIG. 3, <u>a data sorter 20 sorts input data in a magnitude sequence</u>. The data sorter 20 includes median cells 21-29 which sort data in the same manner as that of

> the median cells 11-15 shown in FIG. 1. Thus, data connection lines being concerned with data sorting of the median cells 21-29 are omitted in FIG. 3. <u>The median cells 21-29 are constructed to supply the sorted data to a distance calculator 31 and a multiplexer 33 in a median determiner 30.</u> <u>When external data is input to the data sorter 20, the median cells 21-29 delete the oldest input data among the nine prestored data, and performs an sorting and storage operation with respect to a newly input data and eight prestored data excluding the oldest input data.</u> As a result, the nine data including the one newly input data is stored in a descending order from the leftmost median cell 21 to the rightmost median cell 29. <u>The sorted data stored in the median cells 21-29 are supplied to the median determiner 30.</u> (Emphasis added.)

Thus, although Bae et al. deals with circular data, in contrast to the present invention, Bae et al. teaches performing N-1 (in his example, eight) subtraction operations after the <u>unnormalized</u> data are already entered into the median storage cells 21-29. Bea et al. <u>must</u> then either sort the input data, or else sort the differences, in order to select an output cell. Bea et al. actually sorts the input data.

Furthermore, this sorting taught by Bae, et al. has an order (N^2) run-time impact, which is too time-consuming for operation in software. Rather, the multiple subtraction operations taught by Bae, et al. indicate that the invention is intended only for implementation in hardware where subtraction operations are run in parallel, whereby the run-time impact is overcome.

Bae, et al. thus fails to teach normalizing the input to a range that is based on the current locus, as recited in claim 1.

In contrast to Bae, et al., the present invention **<u>bypasses</u>** the need for the <u>multiple distance computations</u> as taught by Bae, et al. (the eight subtraction operations) by instead computing a <u>locus</u> of the samples, as shown in Figure 6 at Block 110. This normalizing the input to a range that is based on the current locus, as recited in claim 1, results in <u>at most</u> two compare operations: difference > HALFCIRCLE, and difference < -HALFCIRCLE, as shown in Figure 7.

The Examiner asserts that Bae, et al. teaches normalizing a value of an input sample to a range centered on the locus, as recited in claim 1. In support, the Examiner relies on Bae, et al. at column 3, lines 21-33, which reads:

> The distance calculator 31 also uses the following equation (2) in order to obtain a distance D_1 between the data R[8] and R[0] stored in the median cells 21 and 29.
>
> D_1 =□Max-R[0]□+□R[8]-Min□ (2)
>
> Here, the maximum value Max and the minimum value Min are "2pi" "0," respectively, in the case of data expressed as angles. The data calculator 31 prestores the maximum value Max and minimum value Min and calculates a distance between the data R[0] and R[8] using the stored values Max and Min. Column 3, lines 21-33.

The Applicant disagrees. By careful reading beyond the excerpt cited above by the Examiner, the Examiner will readily perceive that, Bae, et al. only appears to determine D_1 as the "center" of the current set of data on the unit circle, Bae, et al. does not use the result to manipulate (i.e., "normalize") the input. Rather, Bae, et al. **actually** teaches using the result to select the output from the sorted list.

> The distances calculated by the distance calculator 31 are input to the comparator 32. The comparator 32 compares the distances supplied from the distance calculator 31, determines a maximum distance, and generates a select control signal CTL for selecting a pair of median cells corresponding to the determined maximum distance. The generated select control signal CTL is input to the multiplexer MUX 33. Column 3, lines 33-40 (emphasis added).
>
> The multiplexer 33 selects one of the data supplied from the median cells 21-29 in the data sorter 20 on the basis of the select control signal CTL received from the comparator 32, and outputs the selected data as median data MOUT. The median value of the data belonging to the definition domain shown in FIG. 2B is data which is the farthest from a pair of data in which a distance between data is the farthest when data is represented according to the magnitude on a circle C. Thus, the multiplexer 33 uses a relationship shown in the following Table, in order to select one of data supplied from the median cells 21-29 based on the select control signal CTL. Column 3, lines 41-52 (emphasis added).

Bae, et al. thus **fails** to teach normalizing the input to a range that is based on the current locus, as recited in claim 1.

For at least the above reasons, the invention recited in claim 1 is believed to be allowable over Bae, et al. as originally presented. Therefore, the Applicant declines to amend claim 1 at this time.

Claims 1-10 are allowable at least as depending from allowable claim 1.

Claims 11, 14, 21 and 28 differ in scope from allowable claim 1. However, the above arguments directed to claim 1 are sufficiently applicable to claims 11, 14, 21 and 28 as to make repetition unnecessary. Thus, for each of the reasons above, claims 11, 14, 21 and 28 are believed to be allowable as originally presented. Therefore, the Applicant declines to amend any of claims 11, 14, 21 and 28 at this time.

Claims depending from base claims 11, 14, 21 and 28 are allowable at least as depending from an allowable base claim.

<u>Claim Rejections Under 35 USC § 103</u>

Claims 4, 5, 7, 8, 26, 27 and 29-32 were rejected under 35 USC § 103(a) over US Patent 5,968,111 to Bae, et al. in view of US Patent 6,018,750 to Connell, et al.

The invention as originally presented is patentable over both Bae, et al. and Connell, et al., individually and in combination.

Claims 4, 5, 7 and 8 all depend from base claim 1.

Claims 26 and 27 depend from base claim 21.

Claims 29-32 depend from base claim 28.

As discussed above, Bae, et al. **<u>fails</u>** to disclose or suggest normalizing the input data **prior** to filtering, as recited in the base claims of the present invention.

Connell, et al. fails to provide the deficiencies of Bae, et al. Connell, et al. teaches a median filter in a misfire detection system. Column 3, lines 28-30.

Connell, et al. also **<u>fails</u>** to disclose or suggest normalizing the input data **prior** to filtering, as recited in the base claims of the present invention. Rather, in contrast to the present invention, Connell, et al. teaches receiving raw data, digitizing the data, storing the digitized data as a list, finding the median data sample from the list of stored data, and generating a median filtered data sample. Column 3, lines 28-65, which read as follows:

> FIG. 1 is a system diagram illustrating an overall approach for applying a median filter in a misfire detection system. An engine crankshaft drives an encoder wheel 101 having marks disposed radially thereon. <u>An accelerometer 103 senses</u>

the rotation of the encoder wheel 101, and outputs a signal 105 indicative of an acceleration of the encoder wheel 101. This signal 105 is coupled into a signal processing system 107. This signal processing system 107 digitizes the signal 105 and provides a discrete time sampled representation of the acceleration behavior of the encoder wheel 101. These discrete time data samples are provided to a storage memory device 109 preferably constructed as a list in taking the form of a circular queue having a length N. As the encoder wheel 101 rotates, each new data sample entry is stored into the storage memory device 109 by writing over the oldest data sample entry. For instance, in FIG. 1 reference number 111 shows the newest data sample which has a value of 135, and an oldest data sample 113 which has value of 143. As a next data sample becomes available--here shown with a value of 98 at reference number 121, the oldest data sample 113 will be written over and replaced by the newest data sample (98). At a much higher rate than the data samples are changing, a grading mechanism 117 is used to find the median data sample within the list represented in the circular queue 109. This continuously graded median value 119, here the data sample having a value 138, is then used to produce a median filtered data sample. This filtering is accomplished by subtracting the continuously graded median value 119 from a time centered data sample from the queue. The result is presented to a misfire detection apparatus 115 which uses this continuously filtered median data sample to determine misfire behavior of the engine. Preferably, the misfire detection apparatus 115 includes a comparison circuit for providing a misfire indication when the median filtered data sample of the data samples in the queue exceeds a misfire threshold. The misfire threshold is preferably programmable and stored in the misfire detection apparatus 115. Column 3, lines 28-65 (emphasis added).

Thus, Connell, et al. does **not** disclose or suggest normalizing the input data **prior** to filtering, as recited in the base claims of the present invention.

For at least the above reasons, the invention recited in claim 1 is believed to be allowable over as originally presented both Bae, et al. and Connell, et al. Therefore, the Applicant declines to amend claim 1 at this time.

Claims 4, 5, 7 and 8 are allowable at least as depending from allowable claim 1.

Claims 21 and 28 differ in scope from allowable claim 1. However, the above arguments directed to claim 1 are sufficiently applicable to claims 21 and 28 as to make repetition unnecessary. Thus, for each of the reasons above, claims 21 and 28 are believed to be allowable as originally presented.

Claims 26 and 27 are allowable at least as depending from allowable base claim 21.

Claims 29-32 are allowable at least as depending from allowable base claim 28.

Furthermore, Connell, et al. operates completely differently from the present invention, which recites computing a locus of the samples, in claim 1.

Rather, in contrast to the present invention, Connell, et al. teaches subtracting the median value **119** in the magnitude-sorted list from the <u>median</u> value in the time-ordered list in order to select the new output cell index, which Connell, et al. states as, "This filtering is accomplished by subtracting the continuously graded median value 119 from a time centered data sample from the queue." Column 3, lines 54-57 (above).

Additionally, Connell, et al. describes the function of a median filter as operating by "subtracting the median result from the time ordered data sample positioned at the center of the time ordered list." See, column 1, lines 64-67, as follows:

> Digital or sampled data type median filters function by operating on a fixed-length list of data samples. The median filter determines which sample present on the fixed-length list represents a value arithmetically median within the list. Some prior art median filters used a storage memory intensive scheme for resolving the median value within a list of data samples. For instance, once a list is filled with data it is sorted into an arithmetically ordered list and the data sample positioned in the center of the list becomes the median result. <u>By subtracting the median result from the time ordered data sample positioned at the center of the time ordered list a median filtered data sample can be synthesized.</u> This can be shown more clearly with an example. Column 1, lines 55-67 (emphasis added).

Subtracting the median value in the magnitude-sorted list from the <u>median</u> value in the time-ordered list in order to select the new output cell index, as taught by Connell, et al. is entirely different from subtracting the median value in the magnitude-sorted list (i.e., the locus) from the <u>most recent</u>

value in the time-ordered list (i.e., the input value) in order to normalize the input sample relative to the locus, as recited in claim 1.

For at least the above additional reasons, the invention recited in claim 1 is believed to be allowable over as originally presented both Bae, et al. and Connell, et al. Therefore, the Applicant declines to amend the claims at this time.

Additionally, Connell, et al. deals only with linear data. Connell, et al. mentions a "circular queue 109" at column 3, lines 38-40, "These discrete time data samples are provided to a storage memory device 109 preferably constructed as a list in taking the form of a circular queue having a length N." However, this description makes it clear that Connell, et al. is only teaching deleting the oldest data sample when a new data sample is stored. Connell, et al. does not actually operate on circular data. For at least this reason, Connell, et al. is not even applicable to the circular data type that is the subject of the present invention. Therefore, Connell, et al. fails completely to even address the key element of normalizing a value of an input sample to a range centered on the locus prior to filtering, as recited in the present invention claims. Nor would such normalizing be relevant to the linear data that is the subject of Connell, et al.

Furthermore, Connell, et al. cannot be combined with Bae, et al. Bae, et al. deals with circular data, while Connell, et al. deals only with linear data. The teaching of Connell, et al. are therefore not even relevant to the circular data that is the subject of Bae, et al.

Because Bae, et al. and Connell, et al. deal in completely different data types, the teachings of Connell, et al. are not applicable to invention of Bae, et al. Furthermore, the teachings of Connell, et al. would require undue experimentation to be applied to the circular data operations taught by Bae, et al. For at least the above reasons, Connell, et al. cannot be combined with Bae, et al. to support an obviousness rejection under 35 USC § 103(a).

Allowable Subject Matter

The Examiner is thanked for indicating that claims 9 and 33 contain allowable subject matter and would be allowable if rewritten in independent form. However, the Applicant believes that the base claims 1 and 28 from which claims 9 and 33 depend, respectively, are allowable as originally recited and repeated here. Therefore, the Applicant declines to rewrite claims 9 and 33 at this time.

<u>Newly Presented Claims</u>

New claims 49-53 are presented herein. The subject matter of the newly presented claims, receiving a plurality of normalized data samples, is fully supported by the Specification and Figures of the instant patent application as originally filed. See, for example, Figure 8 and paragraph [0042] of the published application, as follows:

> [0042] FIG. 8 is one example of the invention embodied as a circular median filter 200 having a plurality of machine instructions stored in a memory 208, which are retrieved and operated by a processor 210. <u>Normalized data are input to the processor 210 and a data calculator 212 computes the locus of the normalized data samples as the average of the old data retrieved from memory 214.</u> The data calculator 212 computes the locus as an approximation having a greater or lesser degree of mathematical precision depending upon the desired response. The average "L" produced by the computation is output to a distance calculator 216 that also receives the input data. The distance calculator 216 computes the distances D[1], D[2], through D[N] between each of the input values and the locus. The computed distances D[1]-D[N] are output to a first comparator 218, which compares the computed distances D[1]-D[N] with a maximum permissible value. If the distance between the input value and the locus is less than +-180 degrees, the computed distances D[1]-D[N] are output to a conventional median or other distance-based filter 220, as described herein. However, if one or more of the computed distances D[1]-D[N] between the input value and the locus exceeds +-180 degrees, the sample is passed to a first normalizer 222, which normalizes the sample by adding or subtracting 360 degrees so that the sample is within +-180 degrees of the locus. The distance-based filter 220 is applied to the resulting samples, computed distances D[1]-D[N], as described above, and outputs a median value "M." The output value M of the distance-based filter 220 is passed to a second comparator 224 and compared with predetermined limits of normalization. If the output value of the distance-based filter 220 are within the predetermined limits of normalization, the output value M is provided. However, if the output value of the distance-based filter 220 exceeds the predetermined limits

of normalization, the output value and the internal filter storage locations are passed to a second normalizer 226, which appropriately normalizes the data before outputting the median value M. The output of the distance-based filter 220 is thus the circular median value, which can be used by downstream processing.

Therefore, no new matter is added.

The claims now being in form for allowance, reconsideration and allowance is respectfully requested.

If the Examiner has questions or wishes to discuss any aspect of the case, the Examiner is encouraged to contact the undersigned at the telephone number given below.

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